1G-3G Wireless Communications Potentials in Airport Surface and in Air

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Evolution to 3G

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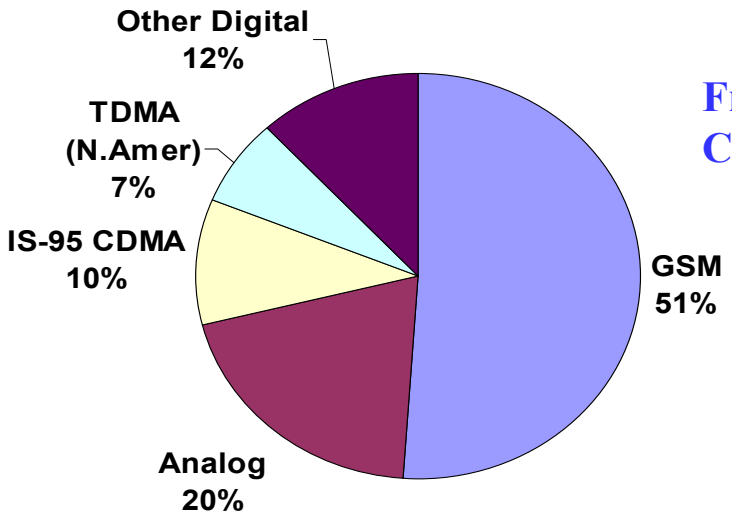
Today	Intermediate	Future
2G	2+1/2 G	3G
up to 9.6 Kbits/sec	up to 177 Kbits/sec	up to 2000 Kbits/sec

GSM → GPRS → EDGE → 3GPP WCDMA UTRA CDMA (UMTS) / UTRA TDD

Introduction of EDGE Compact in the 850 MHz band was abandoned and replaced by migration of IS-136 to GSM, GPRS, EDGE, UMTS

IS-136 → (X) EDGE Compact, UWC136+ → (X) 3GPP WCDMA UTRA CDMA (UMTS) / UTRA TDD

CDMA IS-95 → CDMA 1X → 3GPP2 CDMA 2000



From CTO/1, CTO/2 to..... DECT

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Cellular/PCS Network Architecture

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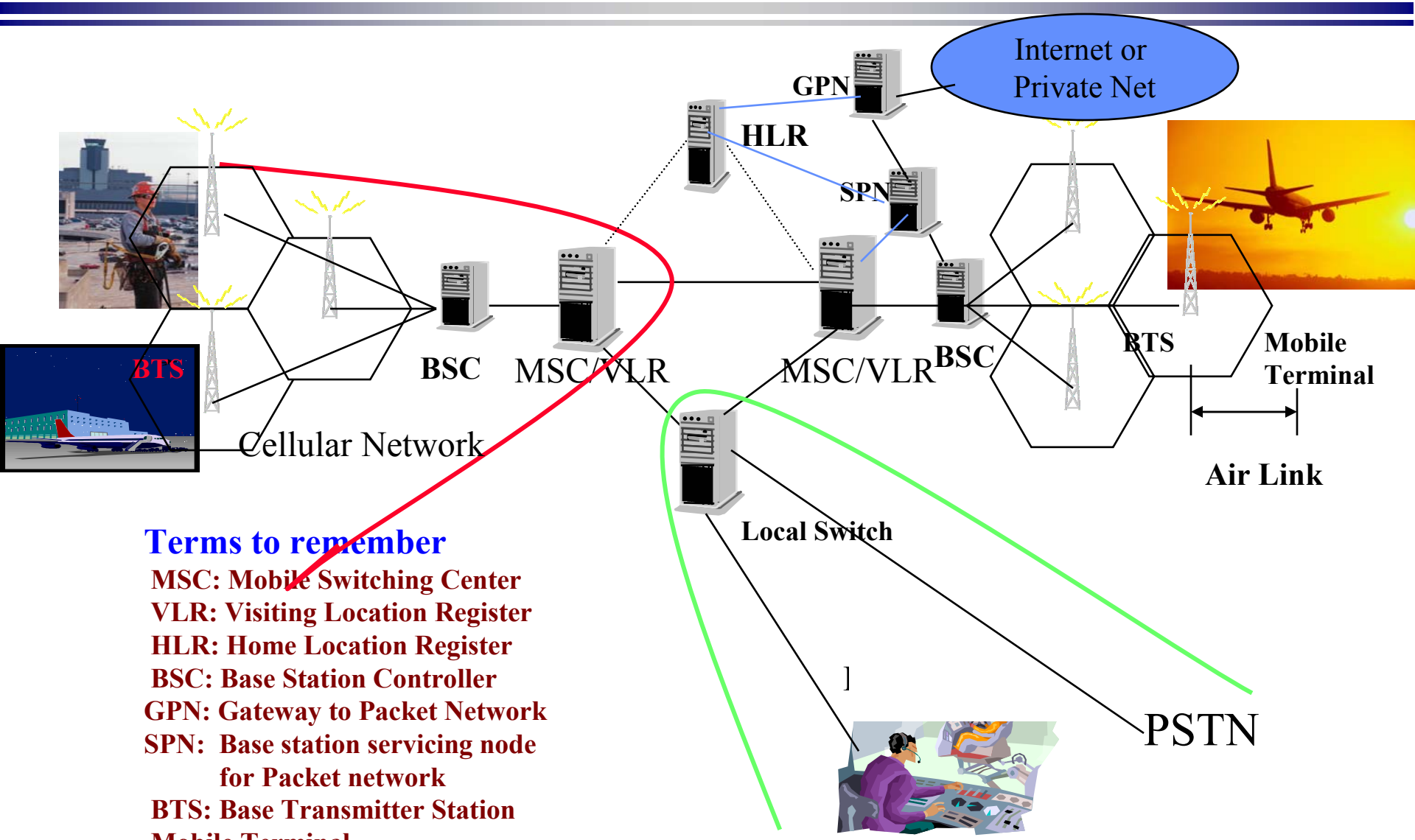

Terms to remember

MSC: Mobile Switching Center
VLR: Visiting Location Register
HLR: Home Location Register
BSC: Base Station Controller
GPN: Gateway to Packet Network
SPN: Base station servicing node for Packet network
BTS: Base Transmitter Station
Mobile Terminal
Air Link

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ATM Applications Traffic Data Loads

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Based on predicted traffic by year 2015 (referenced from ARINC/TRW/SAIC report)

Domains are defined as 10 minutes flights in airport and terminal and 50 minutes in en route. Traffic corresponds to 192 aircraft at airport, 137 aircraft in terminal, and 500 in en route

Data Message Traffic for All Classes of Aircraft (K-bits per second)						
2015	**Airport Uplink**	**Airport Downlink**	**Terminal Uplink**	**Terminal Downlink**	**En Route Uplink**	**En Route Downlink**
FIS	0.2	0.0	0.9	0.0	6.9	0.0
TIS	23.7	0.0	7.0	0.0	20.5	0.0
CPDLC	3.4	2.9	1.3	0.9	1.1	1.3
DSSDL	0.2	0.3	0.1	0.2	0.1	0.1
AOC	0.4	8.4	0.6	8.5	0.2	3.5
ADS Reporting	0.0	16.1	0.0	3.3	0.0	1.5
AUTOMET	0.0	0.0	0.0	4.4	0.0	6.2
APAXS	0.0	0.0	0.0	0.0	131.7	115.5

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A GPRS Analyses/Simulation Under Airport Traffic Loads

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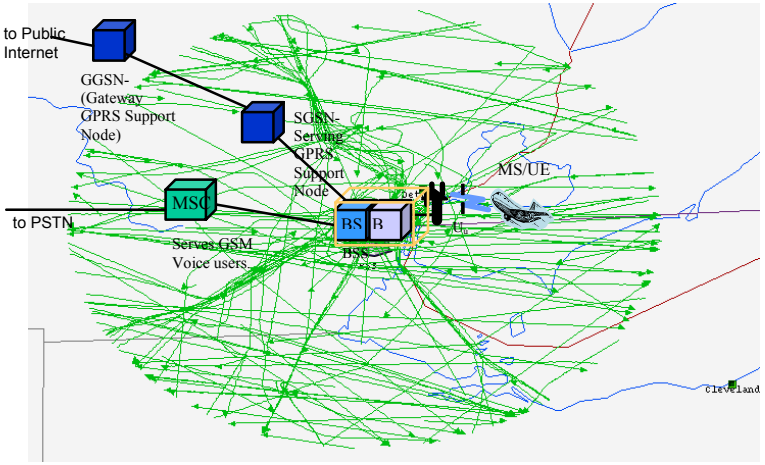
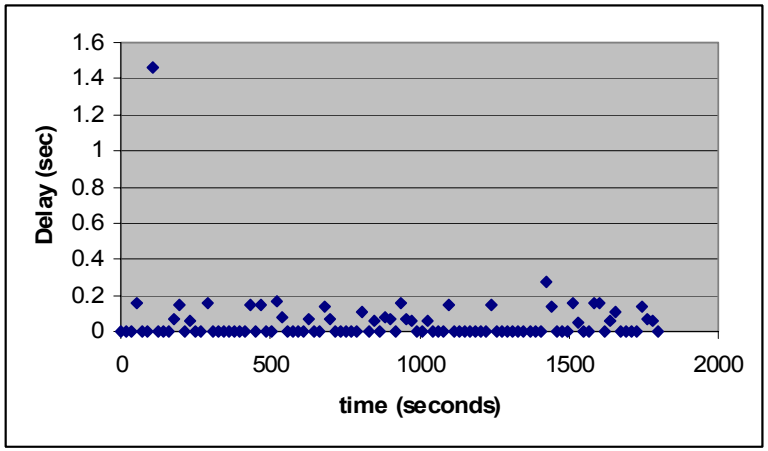
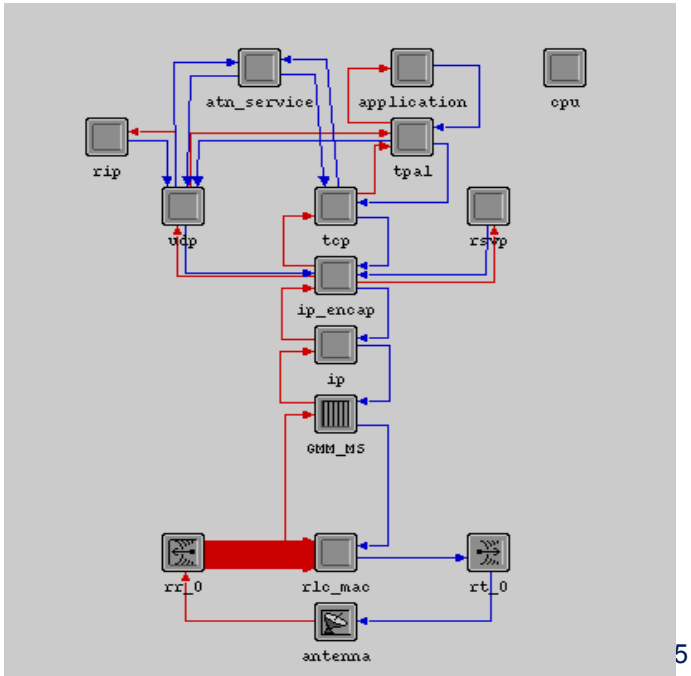
Reliability Class	Lost SDU probability	Duplicate SDU Probability	Out of sequence SDU prob.	Corrupt SDU probability
1	10^{-9}	10^{-9}	10^{-9}	10^{-9}
2	10^{-4}	10^{-5}	10^{-5}	10^{-6}
3	10^{-2}	10^{-5}	10^{-5}	10^{-2}

Delay Class for Standard Data Unit SDU	SDU of 128 bytes		SDU of 1024 bytes	
	Mean (seconds)	95th percentile (seconds)	Mean (seconds)	95th percentile (seconds)
1	Less than 0.5	Less than 1.5	Less than 2	Less than 7
2	Less than 5	Less than 25	Less than 15	Less than 75
3	Less than 50	Less than 250	Less than 75	Less than 375

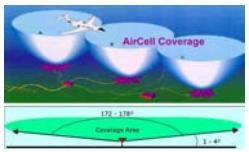






1G-3G systems/experiments useful to ATM future research

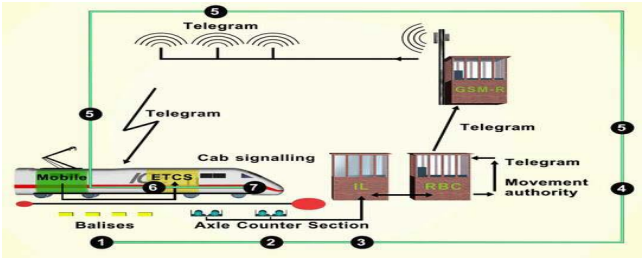
- The AirCell for example provides the capability for Internet connection (using circuit switched data) and have been used with transmission of low resolution graphics from NEXRAD weather images

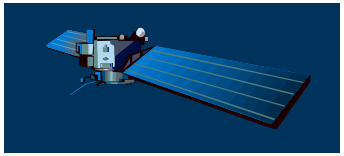


- The Iridium has been shown to support ADS-A via experimental tests in Alaska with the Capstone Projects by the FAA

- The current system AST-3500 by AirCell/Iridium uses the two technologies described to provide global coverage for aeronautical services

- GSM-Rail (used to control, operate train traffic and signaling) is a good bench mark for systems tailored for safety critical systems. Trains used a Has been deployed in many places around the world.



- EUROCONTORL and Roke Manor did experiments to support ATM communications via UMTS TDD in 2002/03. Results were encouraging.

- Satellite and terrestrial UMTS integration has been heavily researched in global projects such as RACE ACTS SINUS and other projects.